

The effects of catchment and riparian forest quality on stream environmental conditions across a tropical rainforest and oil palm landscape in Malaysian Borneo

ABSTRACT

Freshwaters provide valuable habitat and important ecosystem services but are threatened worldwide by habitat loss and degradation. In Southeast Asia, rainforest streams are particularly threatened by logging and conversion to oil palm, but we lack information on the impacts of this on freshwater environmental conditions, and the relative importance of catchment versus riparian-scale disturbance. We studied 16 streams in Sabah, Borneo, including old-growth forest, logged forest, and oil palm sites. We assessed forest quality in riparian zones and across the whole catchment and compared it with stream environmental conditions including water quality, structural complexity, and organic inputs. We found that streams with the highest riparian forest quality were nearly 4 °C cooler, over 20 cm deeper, had over 40% less sand, greater canopy cover, more stored leaf litter, and wider channels than oil palm streams with the lowest riparian forest quality. Other variables were significantly related to catchment-scale forest quality, with streams in the highest quality forest catchments having 40% more bedrock and 20 times more dead wood, along with higher phosphorus, and lower nitrate-N levels compared to streams with the lowest catchment-scale forest quality. Although riparian buffer strips went some way to protecting waterways, they did not maintain fully forest-like stream conditions. In addition, logged forest streams still showed signs of disturbance 10–15 years after selective logging. Our results suggest that maintenance and restoration of buffer strips can help to protect healthy freshwater ecosystems but logging practices and catchment-scale forest management also need to be considered.